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Remarks/Arguments

Applicants respectfully request favorable reconsideration of the subject application, particularly in view of the above amendment and the following remarks. There is no additional fee for the above amendment because the number of independent claims and the total number of claims in the application have been reduced.

Claims 1-17 are pending in the subject application. Claims 10-17 have been canceled as the result of an election made by Applicants in response to a requirement for restriction imposed by the Examiner on the subject application, and Claims 1-9 have been rejected.

Applicants have amended Claims 4, 8 and 9 to clarify the limitations of the claimed methanation catalyst employed in the claimed invention. In particular, Applicants have amended the Markush grouping of elements recited in these claims to better comply with the requirements of MPEP § 2173.05(h). Applicants have also amended Claims 1, 2, 5, and 6 by deleting the term “catalyst” when referring to the water-gas shift and methanation zones within the claimed reactor vessel so as to more clearly describe the nature of the zones. Applicants respectfully urge that this amendment is fully supported, for example, at Page 7, line 8-10 of the specification where Fig. 1 of the drawings is described as showing a reactor vessel for carrying out

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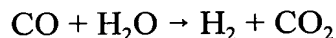
catalytic water-gas shift and catalytic selective methanation reactions. Also, as described at Page 7, line 19 to Page 8, line 3, the catalysts employed in the claimed apparatus are for carrying out water-gas shift reactions and methanation reactions and they are loaded into the respective water-gas shift catalyst zone and the methanation zone for carrying out such reactions. Accordingly, Applicants respectfully urge that this amendment is fully supported by the subject application as originally filed and, thus, incorporates no impermissible new subject matter into the application.

Claims 4, 8 and 9 have been rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. In particular, the Examiner has indicated that the recitation of the limitation(s) “methanation catalyst is selected from the group consisting of nickel, iron, ruthenium, platinum, rhodium and alloys and combinations thereof” constitutes an improper Markush group. Applicants respectfully disagree. Notwithstanding, Applicants have amended Claims 4, 8 and 9 to more clearly recite the elements comprising the Markush group recited therein. Accordingly, Applicants respectfully urge that this amendment overcomes this rejection.

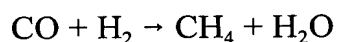
The invention claimed by Applicants is a reactor for CO control comprising a reactor vessel in which there is a water-gas shift zone in which water-

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gas shift reactions are carried out, a mixed catalyst zone downstream of the water-gas shift catalyst zone, and a methanation zone disposed downstream of the mixed catalyst zone in which methanation reactions are carried out. At least one water-gas shift catalyst is disposed in the water-gas shift zone; at least one methanation catalyst is disposed in the methanation zone; and a mixture of the at least one water-gas shift catalyst and the at least one methanation catalyst is disposed in the mixed catalyst zone. *The crux of this invention is the mixed catalyst zone in which the mixture of water-gas shift catalyst and methanation catalyst is disposed.* As known to those skilled in the art, the water-gas shift reaction



is exothermic and the preferred methanation reaction



is also exothermic. Applicants have found that by mixing the water-gas shift catalyst with the methanation catalyst in a mixed catalyst zone disposed between the water-gas shift zone and the methanation zone, *a synergistic effect* is created whereby the heat released by the exothermic water-gas shift reaction can be employed as a means for controlling conditions in the selective methanation catalyst zone, for example reducing or even eliminating the requirement for auxiliary heat input to the methanation catalyst zone. Applicants respectfully urge that the prior art relied upon

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by the Examiner as the basis for rejection of the subject application neither teaches nor suggests the invention claimed by Applicants.

Claims 1-9 have been rejected under 35 U.S.C. 102(b) as being anticipated by Edlund et al. U.S. Patent 5,997,594 (hereinafter “the Edlund et al. patent”). This rejection is respectfully traversed. The Edlund et al. patent teaches a steam reformer with internal hydrogen purification means in which hydrogen containing concentrations of carbon monoxide and carbon dioxide are produced by reacting an alcohol vapor, such as methanol, or a hydrocarbon vapor, such as propane, and steam to produce product hydrogen, carbon monoxide and carbon dioxide. This *reforming reaction* is carried out in the presence of a *reforming catalyst* 102 disposed within a *reforming region* 62 of the steam reformer 12 (Fig. 3; Col. 2, lines 18-40; Col. 5, lines 52-55). Nowhere does the Edlund et al. patent teach or suggest the presence of a water-gas shift zone in which is disposed a water-gas shift catalyst for promoting a water-gas shift reaction as required by Applicants’ claimed invention. In contrast to the invention claimed by Applicants, the initial reaction zone of the apparatus of the Edlund et al. patent is a *reforming zone*. This reforming reaction is carried out in the vicinity of a membrane tube 54 composed of a hydrogen-permeable and hydrogen-selective material through which hydrogen produced in the reforming reaction zone migrates into a hydrogen transport region 64. The hydrogen stream 103,

which includes impurities such as carbon monoxide, carbon dioxide, and unreacted methanol and water vapor is transported into an innermost tube 56 within which is disposed a polishing catalyst 110, which reacts with the impurities in the hydrogen stream to convert them to, for example, methane. The catalyst is identified at Col. 6, lines 44-56 as a methanation catalyst, and the reaction carried out within this innermost tube is a methanation reaction. To convert unreacted methanol within the hydrogen stream, a *reforming catalyst*, which is a low temperature copper/zinc shift catalyst, is placed through a portion (e.g. one-fourth to one-third) of the methanation catalyst bed, followed downstream by a plain methanation catalyst (Col. 6, lines 57-67). Thus, to the extent that there is a mixture of catalysts disposed within the innermost tube 56 of the apparatus of the Edlund et al. patent, the mixture is made up of a *reforming catalyst* for reforming the methanol within the innermost tube and a methanation catalyst. In contrast thereto, the catalysts disposed within the mixed catalyst zone of the reactor claimed by Applicants are a water-gas shift catalyst and a methanation catalyst.

To summarize, the Edlund et al. patent teaches a steam reformer having three reaction zones, a steam reforming zone containing a reforming catalyst in which methanol or other hydrocarbon fuels are converted to hydrogen, carbon monoxide, and carbon dioxide, a mixed catalyst zone disposed downstream of the reforming zone

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and containing a mixture of a reforming catalyst and a methanation catalyst, and a methanation zone disposed downstream of the mixed catalyst zone and containing only a methanation catalyst. In contrast thereto, the invention claimed by Applicants is a reactor vessel comprising a water-gas shift zone containing a water-gas shift catalyst in which carbon monoxide and water are reacted to produce hydrogen and carbon dioxide, a mixed catalyst zone disposed downstream of the water-gas shift zone and containing a mixture of water-gas shift catalyst and methanation catalyst, and a methanation zone disposed downstream of the mixed catalyst zone and containing a methanation catalyst in which carbon monoxide and hydrogen are reacted to produce methane and carbon dioxide. Accordingly, *given the fact that the Edlund et al. patent neither teaches nor suggests a reaction vessel having the zones and respective catalysts disposed therein as claimed by Applicants*, Applicants respectfully urge that the Edlund et al. patent does not anticipate the invention claimed by Applicants in the manner required by 35 U.S.C. 102(b).

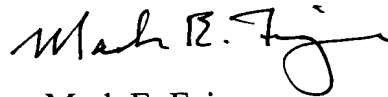
Conclusion

Applicants intend to be fully responsive to the outstanding Office Action. If the Examiner detects any issue which the Examiner believes Applicants have not addressed in this response, Applicants urge the Examiner to contact the undersigned.

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Applicants sincerely believe that this patent application is now in condition for allowance and, thus, respectfully request early allowance.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Mark E. Fejer", with a stylized flourish at the end.

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